Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Ailanthus altissima* (P. Mill.) Swingle (USDA 2005)
Synonyms:	*Ailanthus glandulosa* Desf. (USDA 2005)
Common names:	Tree of heaven, Chinese sumac, paradise-tree, copal-tree, stink tree
Evaluation date (mm/dd/yy)**:**	08/02/04
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Committee review date:	09/24/04
List date:	09/24/04
Re-evaluation date(s):	

Table 2. Scores, Designations, and Documentation Levels

Question		Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**B**	Reviewed scientific publication	**"Impact"** **Section 1 Score:** **B**	**"Plant Score"** **Overall Score:** **Medium** **Alert Status:** **None**
1.2	Impact on plant community	**A**	Reviewed scientific publication		
1.3	Impact on higher trophic levels	**U**	Other published material		
1.4	Impact on genetic integrity	**D**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	Other published material	**"Invasiveness"** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **13 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**B**	Observational		
2.3	Recent trend in total area infested within state	**C**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**B**	Other published material		
2.6	Potential for natural long-distance dispersal	**C**	Reviewed scientific publication		
2.7	Other regions invaded	**B**	Other published material		
3.1	Ecological amplitude	**A**	Observational	**"Distribution"** **Section 3 Score:** **B**	RED FLAG **NO** Something you should know.
3.2	Distribution	**C**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**
Identify ecosystem processes impacted: Changes local soil chemistry in the top 10 cm through allelochemicals.
Rationale: *Ailanthus altissima* produces the highly phytotoxic quassinoid compound ailanthone (Heisey 1996), which is detectable in the surrounding soil in concentration and negatively correlated to distance from young *A. altissima* plants (Lawrence et al. 1991).
Sources of information: See cited literature.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**
Identify type of impact or alteration: Alters forest structure and natural successional processes by invading natural gaps in forests and persisting. Through allelopathy *A. altissima* could reduce emergence and shoot biomass of neighboring plants.
Rationale: Ailanthus has invaded and is persistent in naturally occurring forest gaps, in New York (Knapp and Canham 2000) and West Virginia (Kowarik 1995). It typically has a greater height and diameter than those of the tallest native competitors within those gaps leading to a change in forest structure (Heisey 1996). *Ailianthus altissima* frequently forms dense self-perpetuating clonal clumps through root sprouting (Rabe 1985 in Howard 2004). Mergen (1959) first demonstrated that concentrated extracts of *A. altissima* are toxic to 35 species of gymnosperms and 10 species of angiosperms including the following Arizona natives: *Pinus cembroides, Pinus flexilis, Pinus ponderosa, Picea engelmannii, Abies concolor, Populus tremuloides,* and *Salix bebbiana*, with the negative effect proportional to the concentration (Mergen 1959). In more recent greenhouse studies, application of low levels of aquaeous extracts of *A. altissima* reduced emergence and shoot biomass of plants (Heisey 1996) and resulted in the mortality of five of seven species tested (Heisey 1990). In a natural environment Lawrence et al. (1991) found that *Teucrium canadense* plants growing near (<1 m away) young *A. altissima* plants had significantly higher levels of *A. altissima* toxins compared to plants growing further away (>10 m), suggesting that adjacent plants uptake *A. altissima* toxins from the soil.
Sources of information: See cited literature.

Question 1.3 Impact on higher trophic levels *Score:* **U** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: No formal studies of higher trophic level impacts in Arizona found. May compete for pollinators. May be avoided by herbivores.
Rationale: The large flower display of *A. altissima* is reported to attract numerous pollinators (Miller 1990) but ecological impact on these pollinators is unknown. White-tailed deer may avoid *A. altissima* suggested by lack of significant difference in seedling establishment between open and exclosed plots (Forgione 1993 cited in Howard 2004). The bark and leaves contain saponins, quassinoids, and other bitter compounds that may discourage consumption (Heisey 1996).
Sources of information: See cited literature.

Question 1.4 Impact on genetic integrity *Score:* **D** *Doc'n Level:* **Other pub.**
Identify impacts: No known hybridization.
Rationale: No closely related native (or non-native) species occur in Arizona (Kearney and Peebles 1960).
Sources of information: See cited literature.

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: *Ailanthus altissima* establishes most often in areas of anthropogenic disturbance but can establish in areas opened up by natural disturbance.
Rationale: Observations in Arizona indicate that *A. altissima* primarily establishes in severely disturbed areas such as abandoned mines, industrial parks, and areas of other major human disturbance (F. Northam, personal communication, 2004). In addition to human disturbed areas near where it was planted as a landscape tree; however, *A. altissima* is found in naturally disturbed riparian areas (Tellman 1997; B. Phillips, personal communication, 2003). These local observations are consistent with reports from other states (Hu 1979, Santamour 1983, Rabe and Bassuk 1984, Miller 1990) and throughout North America. *Ailanthus altissima* is recognized as a shade intolerant (Grime 1965), gap-obligate (Knapp and Canham 2000) early seral species.
Sources of information: See cited literature. Also considered personal communications with F. Northam (Weed Biologist, Tempe, Arizona, 2004) and B. Phillips (Botanist, U.S. Department of Agriculture, Forest Service, Coconino, Kaibab, and Prescott National Forests, 2003).

Question 2.2 Local rate of spread with no management *Score:* **B** *Doc'n Level:* **Obs.**
Describe rate of spread: Increasing slowly.
Rationale: In naturally disturbed areas, *A. altissima* is likely to spread relatively quickly for a tree due to a rapid growth rate and clonal growth through root sprouting (Howard 2004). Despite the potential for rapid local spread, F. Northam (personal communication, 2004) has not observed any spread of *A. altissima* in areas that are not disturbed by humans. For the purposes of this assessment, the Working Group considered human-mediated disturbance a management activity and thus excludes observations of spread in areas heavily disturbed by humans. Based on the potential for natural disturbance to enable the spread of this species, the Working Group considered the rate of spread without management to be low but not stable.
Sources of information: See cited literature. Also considered personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004).

Question 2.3 Recent trend in total area infested within state *Score:* **C** *Doc'n Level:* **Obs.**
Describe trend: Stable.
Rationale: Francis Northam (personal communication, 2004) reports that *A. altissima* is almost exclusively confined to severely disturbed sites and besides these large disturbances he has observed no current expansion of *A. altissima* in Arizona. In California, where the behavior of *A. altissima* is likely more similar to Arizona than northeastern states, establishment by seed is reportedly low (Hunter 2000). This factor may be responsible for the apparent stable rate of spread to new areas in Arizona.
Sources of information: See cited literature. Also considered personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004).

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Other pub.**
Describe key reproductive characteristics: Dominate reproduction is vegetative by root sprouts. Trees are primarily dioecious; females produce an abundance of short-lived (<1 year), wind-dispersed, samaras.
Rationale: See also Worksheet A. Asexual reproduction is by vegetative sprouting from stumps or root portions (Hu 1979, Kowarik 1995, Howard 2004). Individual trees can produce 325,000 or more seeds per year (Bory and Clair-Maczulajtys 1980 cited in Hoshovsky 1988). *Ailanthus altissima* seeds retain dormancy for less than a year and do not build up a long-term seed bank (Hunter 2000).
Sources of information: See cited literature.

Question 2.5 Potential for human-caused dispersal *Score:* **B** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Planted for commercial and domestic landscape beautification and reclamation.
Rationale: Available for purchase over the internet. Proposed for use to stabilize mine tailings, but not recommended (Hunter 1995 cited by Howard 2004).
Sources of information: See cited literature.

Question 2.6 Potential for natural long-distance dispersal *Score:* **C** *Doc'n Level:* **Rev. sci. pub.**
Identify dispersal mechanisms: Dispersed by wind vis-à-vis winged fruit.
Rationale: Matlack (1987) developed a formula to estimate lateral distance of released diaspore from a given height in 10 km/hr wind and estimated a lateral dispersal for *A. altissima* to be about 110 m per 10 km wind.
Sources of information: See cited literature.

Question 2.7 Other regions invaded *Score:* **B** *Doc'n Level:* **Other pub.**
Identify other regions: Overall *A. altissima* is widespread in the continental U.S. from New York, south to Florida, west to California and north to Oregon; however, it has not been documented in Montana, Minnesota, New Hampshire, North Dakota, South Dakota, Vermont, and Wyoming (USDA 2005). In California it occurs in riparian areas and other naturally disturbed habitats at elevations below 6,600 feet (2000 m) (Hunter 2000).
Rationale: In California it occurs in riparian woodland and riparian forest ecological types, which are roughly comparable to Arizona's montane riparian ecological type. Observations have not yet been made of *A. altissima* in montane riparian in Arizona.
Sources of information: See cited literature.

Question 3.1 Ecological amplitude *Score:* **A** *Doc'n Level:* **Obs.**
Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: According to F. Northam (personal communication, 2004), *A. altissima* is limited in Arizona to areas above 3000 feet (for example, near Camp Verde and Globe) to about 7,000 feet (for example, near Jerome). Ecological types infested are some areas of southwestern interior chaparral, but *A. altissima* occurs mainly in forested areas—Ponderosa pine and Madrean evergreen woodland, especially in proximity to disturbed areas. It also is reported from riparian areas (Tellman 1997). As reported in Howard (2004): **Soils/topography:** Tree of heaven tolerates a wide range of soil conditions (Duncan and Duncan 1988, Miller 1990). For example, in oak-hickory woodland of Sussex County, New Jersey, tree of heaven occurs in permanently swampy, ridge bottom soils of an abandoned Boy Scout camp (Barringer and Pannaman 2003). At the other moisture extreme, large, water-storing roots enable tree of heaven to tolerate dry, rocky soils and extended drought. Even seedlings show drought tolerance, often volunteering in pavement cracks and other dry sites (Graves et al. 1989). Best growth occurs on nutrient-rich, loamy soils such as those in the Central Valley of California, but tree of heaven tolerates nutrient-poor soils (Feret and Bryant 1974, Miller 1990, Kentucky Exotic Pest Plant Council 2001, Zasada and Little 2002). In reclamation studies, tree of heaven tolerated acid mine spoils better than calcareous spoils and grew on low-phosphorus soils (Miller 1990). Tree of heaven can grow on soils as low as 4.1 pH, in soluble salt concentrations of 0.25 mmhos/cm, and in soils with phosphorus levels as low as 1.8 ppm (Plass 1975). It tolerates compacted soils (Pan and Bassuk 1985). Tree of heaven's spreading root system permits establishment and growth on cliff faces and other steep inclines (Almeida et al. 1994).

Climate: Tree of heaven is the only species in its genus that tolerates cold climates (Hu 1979). Climate within tree of heaven's North American distribution varies widely, from subtropical and wet in Florida, arid in the Great Plains and Great Basin, to cold and wet in the Northeast. Tree of heaven tolerates as little as 14 inches (360 mm) of annual precipitation under eight months of drought in the arid West and as much as 90 inches (2,290 mm) annual precipitation in the Appalachian Mountains. Annual mean maximum and minimum temperatures are 15 and 97°F (-9 and 36°C). Large, water-storing roots confer drought tolerance. Extreme cold and prolonged snow cover restrict its occurrence to lower slopes in mountainous regions, as seedlings are not cold resistant. Tree of heaven may be able to colonize cold regions that experience several successive years of mild climate (Miller 1990).

Elevation: Tree of heaven grows from 4,900 to 5,900 feet (1,500 to 1,800 m) elevation in China (Hu 1979).

Germination: Flowers from April to May (or later depending on climate) with fruit maturing in the early fall. Flowering can occur as early as six weeks after germination, which is rare in woody angiosperms (Feret 1973). Germination rate is about 60% in a nursery setting.

Rationale: Occurs in four major and four minor ecological types.

Sources of information: See cited literature. Also considered personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004).

Question 3.2 Distribution *Score:* **C** *Doc'n Level:* **Obs.**

Describe distribution: Limited frequency of occurrence (<20%) within each infested ecological type.

Rationale: According to F. Northam (personal communication, 2004), *A. altissima* is limited in Arizona to areas above 3000 feet (for example, near Camp Verde and Globe) to about 7,000 feet (for example, near Jerome). Ecological types infested are some areas of southwestern interior chaparral, but *A. altissima* occurs mainly in forested areas—Ponderosa pine and Madrean evergreen woodland, especially in proximity to disturbed areas. It also is reported from riparian areas (Tellman 1997).

Sources of information: See cited literature. Also considered personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004).

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	**Yes**	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	**Yes**	**No**	**2 pt.**
Populations of this species produce seeds every year.	**Yes**	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	**Yes**	**No**	**1 pt.**
Seeds remain viable in soil for three or more years	**Yes**	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	**No**	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**Yes**	**No**	**1 pt.**
Fragments easily and fragments can become established elsewhere	**Yes**	**No**	**2 pt.**
Resprouts readily when cut, grazed, or burned	**Yes**	**No**	**1 pt.**

Total pts: 6 Total unknowns: 1

Score : A

Note any related traits:

Worksheet B. Arizona Ecological Types

(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	dunes	
Scrublands	Great Basin montane scrub	
	southwestern interior chaparral scrub	**D**
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	
	playas	
Riparian	Sonoran riparian	
	southwestern interior riparian	**C**
	montane riparian	
Woodlands	Great Basin conifer woodland	
	Madrean evergreen woodland	**C**
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	**D**
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

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